4-WIRE FOREIGN EXCHANGE OFFICE WITH VF RESPONSE EQUALIZER (4WFXO/VF) CHANNEL UNIT, 628230, AND 4-WIRE FOREIGN EXCHANGE OFFICE (4WFXO) CHANNEL UNIT, 628235

GENERAL DESCRIPTION

CONTENTS PAGE

1. GENERAL 1
2. DESCRIPTION 1
3. FUNCTIONAL OPERATION (FIG. 3 AND 4) 2
TRANSMIT VF CIRCUIT 2
RECEIVE VF CIRCUIT 2
SIGNALING 2
CARRIER GROUP ALARM 6
BUSY MODE 6
4. OPTIONS 6
5. RESTRICTIONS 6
6. TEST AND MAINTENANCE FEATURES 6
7. TECHNICAL SUMMARY 7
8. REPLACEABLE PARTS 8
9. REFERENCES 8

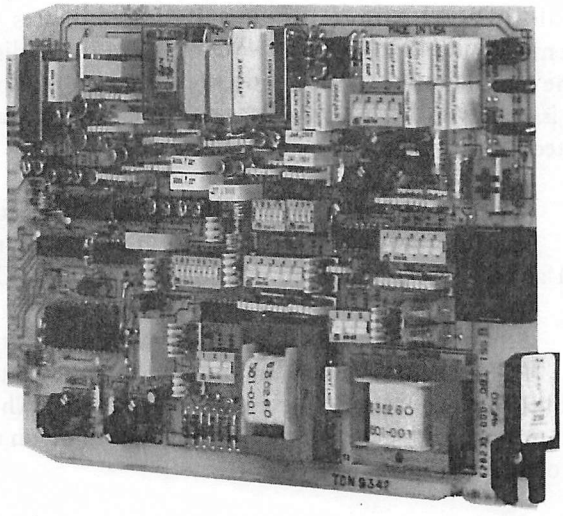


Fig. 1—4WFXO/VF Channel Unit, 628230

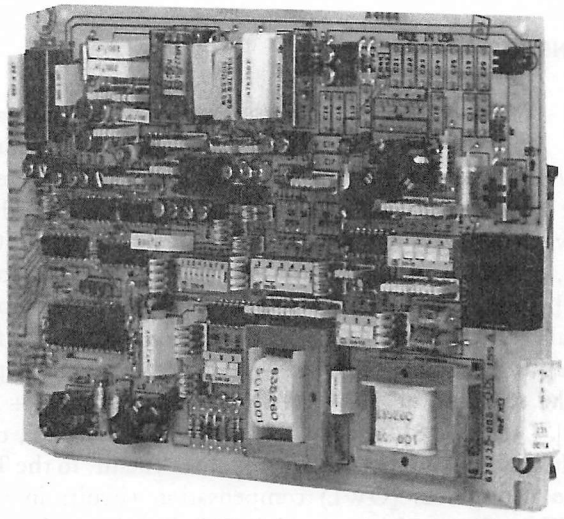


Fig. 2—4WFXO Channel Unit, 628235

1. GENERAL

1.01 This Section provides a general description of the ITT D448 4-wire foreign exchange office with VF response equalizer (4WFXO/VF) channel unit, 628230 (Fig. 1), and 4-wire foreign exchange office (4WFXO) channel unit, 628235 (Fig. 2), to the functional block diagram level.

1.02 Whenever this Section is reissued, the reasons for reissue will be listed in this paragraph.

1.03 The units provide a voice frequency (VF) and signaling interface between the central office (C.O.) equipment and the D448 multiplex terminal common equipment. In the transmit direction, the units convert VF and signaling information into pulse code modulation (PCM) for application to the common equipment. In the receive direction, the units decode received PCM into VF and signaling information. During system outages, the units provide various disconnect/make-busy routines for the trunk. The units provide the office end of a 150-, 600-, or 1200-ohm, ground-start or loop-start foreign exchange message circuit.

2. DESCRIPTION

2.01 Each unit mounts in the D448 multiplex shelf (channel unit mounting section) in connectors

J1A through J24A (for Digroup A) or connectors J1B through J24B (for Digroup B). Installation procedures for the units are provided in Section ITTR-18-441.

2.02 Each unit is available in Group -0 only.

2.03 Each unit consists of an epoxy-glass printed circuit board (PCB) and associated circuit components. The lower front edge of the PCB is fitted with a handle to facilitate insertion and removal of the unit from the shelf. An identification strip on the handle face indicates the unit mnemonic (4WFXO/VF or 4WFXO), last three digits of the model number, last three digits of the part number, and issue letter. The part number and issue letter are also located on the component side of the PCB.

2.04 The LC LED (DS1), the BSY switch (S9), the splitting card jack (J1), and EQ OUT test points (TP1 and TP2) are located on the front edge of the PCB.

2.05 Printed circuit wiring is etched on both sides of the PCB. The unit inputs and outputs are terminated in gold-plated contacts on the rear edge of the PCB. These contacts mate with a 60-pin contact edge connector on the rear of the multiplex shelf.

3. FUNCTIONAL OPERATION (FIG. 3 AND 4)

TRANSMIT VF CIRCUIT

3.01 The incoming VF is transformer-coupled, via part of the transmit (TX) level DIP switch, to the low-pass/high-pass filter where it is amplified and filtered. (The transformer has a multiple-tapped secondary that allows a 600-ohm impedance to be matched to a 150-, 600-, or 1200-ohm line by the selection of switch options [150], [600], or [1200].) The gain applied to the input signal can be varied over a 31-dB range to compensate for VF input levels from +9.0 to −22.0 dBm (in 1-dB steps) by the selection of TX level DIP switch options [+1], [+2], [+4], [+8], and [+16]. In the 4WFXO/VF, the resulting signal is fed, via a VF equalizer circuit, to the TX office wiring loss (OWL) compensation circuit; in the 4WFXO, the resulting signal is fed directly to the TX OWL compensation circuit. The equalizer circuit equalizes the effect of long loaded or nonloaded lines. The equalization may be varied by DIP switch options [L], [N]; SL [1], [2], [4], [8]; HT [1], [2], [4], [8]; and BW [1], [2], [4], [8]. TP1 and TP2 provide a monitoring point for the equalizer circuit. The resulting signal is passed to the TX OWL compensation circuit. The TX prescription OWL options provide 0 to 1.5 dB of gain in 0.1-dB steps to compensate for wiring/cabling losses. The range for input levels is +9.0 to −23.5 dBm in 0.1-dB steps. The resulting signal is applied to the encoder.

3.02 The encoder converts the VF signal and signaling information (Para. 3.05) to an 8-bit PCM word. When the TX AND gate is activated by the transmit logic unit (TLU) on the TCS4-X and TCS6-X leads, the 8-bit word is applied to the TLU via the TCD bus. The data is clocked out of the unit under control of the 1.536-MHz clock from the TLU.

RECEIVE VF CIRCUIT

3.03 An 8-bit PCM word from the receive logic unit (RLU) is applied to the decoder on the RCD bus. The decoder will only accept the data when the receive (RX) AND gate is activated by the RLU on the RCS4-X and RCS6-X leads. The decoder converts the PCM word into a VF signal and signaling information (Para. 3.06).

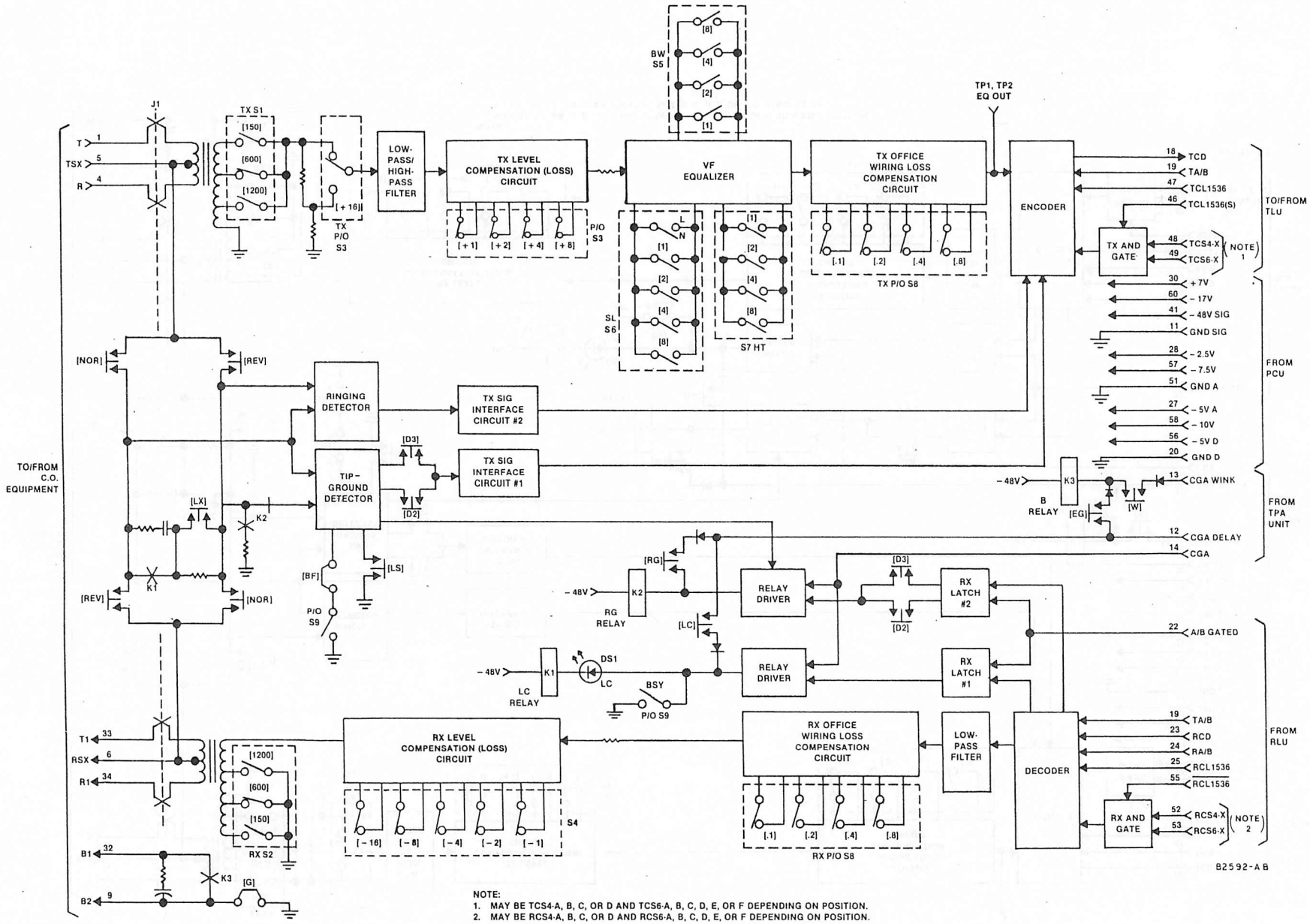
3.04 The VF signal is applied to the low-pass filter and passed through to the RX OWL compensation circuit. The RX prescription OWL options provide 0 to 1.5 dB of gain in 0.1-dB steps to the signal out of the low-pass filter to compensate for office wiring/cabling losses. The output of this circuit is further amplified. This amplification can be varied over a 31-dB range (in 1-dB increments) by the selection of RX VF level DIP switch options [−1], [−2], [−4], [−8], and [−16]. This provides output levels of +10.5 to −22.0 dBm in 0.1-dB increments with both the OWL and VF level options. The amplified VF is transformer-coupled to the C.O. equipment. The transformer and DIP switch options are identical to those described in Para. 3.01.

SIGNALING

A. General

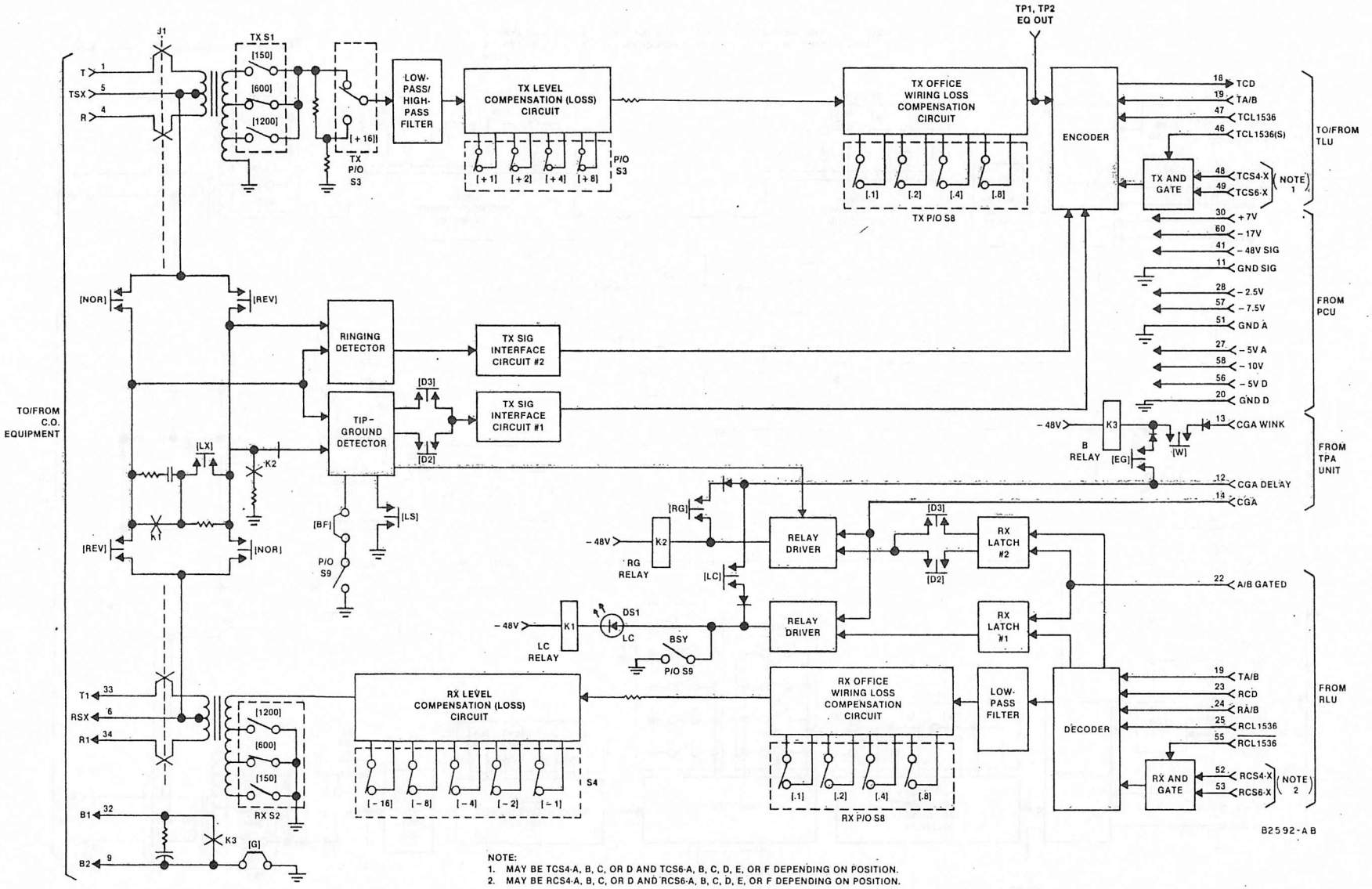
3.05 Signaling information from the C.O. to the units is via the TSX(T,R) and RSX(T1,R1) leads. The signaling information is processed via transmit signaling circuitry and the TX signaling (SIG) interface circuits. The output of the TX SIG interface circuits is applied to the encoder. However, the encoder will not process the information until it is signaled on the TA/B lead by the TLU that the signaling frame is upcoming. Each TX SIG interface circuit is associated with a different signaling frame.

Note: TSX is the transmit path simplex and RSX is the receive path simplex. They also refer to the simplex at the repeat coil end for the purposes of this Section.



NOTE:
1. MAY BE TCS4-A, B, C, OR D AND TCS6-A, B, C, D, E, OR F DEPENDING ON POSITION.
2. MAY BE RCS4-A, B, C, OR D AND RCS6-A, B, C, D, E, OR F DEPENDING ON POSITION.

Fig. 3—4WFXO/VF Channel Unit, 628230, Functional Block Diagram



NOTE:
1. MAY BE TCS4-A, B, C, OR D AND TCS6-A, B, C, D, E, OR F DEPENDING ON POSITION.
2. MAY BE RCS4-A, B, C, OR D AND RCS6-A, B, C, D, E, OR F DEPENDING ON POSITION.

Fig. 4—4WFXO Channel Unit, 628235, Functional Block Diagram

3.06 Signaling information from the far-end foreign exchange subscriber (FXS) channel unit is applied to the decoder along with the VF information from the far end. The decoder converts the receive signaling information from the 8-bit PCM word when it is signaled by the RLU on the RA/B lead that the signaling frame is being processed by the terminal. The decoded signaling information is applied to one of the RX latches. Each RX latch is associated with a different signaling frame. The RX latches and other receive signaling circuitry process the signaling information. This causes signaling conditions to be placed on the drop to the C.O.

3.07 During intermittent terminal failures (momentary failures), the RX latches are inhibited from processing signaling information. This results in signaling state storage. This forces the unit to remain in its previous state (idle or busy) during the momentary failure to keep from dropping connections or to keep the unit from being accessed. The signaling state storage is controlled by the RLU. During a momentary failure, the RLU prevents the A/B GATED lead from making a transition which inhibits the RX latch.

B. Outgoing Call

3.08 The following paragraphs describe the signaling functions of the units when a call is being processed from the C.O. to the far-end FXS channel unit with both [NOR] option screws selected (down) and both [REV] option screws open (up). When both [REV] option screws are selected (and both [NOR] option screws are up), ring ground will be on the TSX lead. Also by selecting option screw [LX], loop resistance presented to the C.O. is changed from 500 ohms (normal) to 10 ohms. This option is used only for long loops.

3.09 The C.O. grounds the TSX lead and applies ringing voltage to the RSX lead. In loop-start operation, the C.O. maintains a permanent ground on the TSX lead, and ground is permanently applied to the tip-ground detector via option screw [LS]. The tip-ground detector detects the presence of ground on the TSX lead (or through option screw [LS]) and signals the TX SIG interface circuit #1 to transmit this information to the far end. Option screws [D2] and [D3] condition the signaling to be compatible with D2-type signaling or D3-/D1D-type signaling, respectively. When the tip-ground detector detects the presence of ground, it inhibits the RG relay from energizing, thereby keeping the unit from grounding the RSX lead to the C.O.

3.10 When the far-end FXS channel unit receives the tip ground information, it too grounds its tip lead. This completes part of its ringing path and inhibits it from sending a ring ground to the near end.

3.11 The ringing voltage on the drop of the 4WFXO/VF or 4WFXO channel unit is detected by the ringing detector. The ringing detector applies this information to the TX SIG interface circuit #2 for transmission to the far end.

3.12 When the FXS channel unit receives the ringing information from the 4WFXO/VF or 4WFXO, it completes its ringing path and applies ringing to its drop to the subscriber. When the FXS senses a loop closure (off-hook) at the drop, it trips ringing, and transmits the loop closure information to the 4WFXO/VF or 4WFXO.

3.13 The loop closure information from the far end is applied to the RX latch #1. RX latch #1 and the relay driver turn on the LC LED and energize the LC relay. This causes the drop to the C.O. to be closed. This trips ringing at the C.O. and completes the talk path from the 4WFXO/VF or 4WFXO to the FXS.

C. Incoming Call

3.14 The following paragraphs describe the signaling functions of the units when a call is being processed from the far-end 4WFXS to the C.O. with both [NOR] option screws selected (down) and both [REV] option screws open (up). When both [REV] option screws are selected (and both [NOR] option screws are up), ring ground will be on the TSX lead to the C.O. and tip-ground on the RSX lead from the C.O. Also by selecting option screw [LX], loop resistance presented to the C.O. is changed from 500 ohms (normal) to 10 ohms. This option is used only for long loops.

3.15 The FXS at the far end is seized when its loop is closed. In ground-start operation, its ring lead is grounded at the same time. In loop-start operation, a permanent ground is placed on its tip lead by the FXS.

3.16 In ground-start operation, the FXS does not recognize the loop closure because its tip lead is open. It sends its ring ground condition to the 4WFXO/VF or 4WFXO. The ring ground information is applied to the RX latch #2. RX latch #2 and the relay driver energize the RG relay. This grounds the RSX lead to the C.O. The C.O. recognizes this as a request for service from the subscriber and grounds the TSX lead. This is detected by the tip-ground detector which sends this infor-

mation to the far end via TX SIG interface circuit #1. This signal also causes the RG relay to deenergize. When the far-end FXS receives the tip ground information, it too grounds its tip lead. This completes its loop at the drop and permits dialing to take place. Dialing occurs by pulsing of the loop at the FXS. The FXS transmits this condition to the 4WFXO/VF or 4WFXO. The loop pulsing information from the far end is applied to RX latch #1. RX latch #1 and the relay driver pulse the LC LED on/off and energize and deenergize the LC relay to recreate the dial pulsing at the drop to the C.O. At the conclusion of dialing, the talk path from the FXS to the 4WFXO/VF or 4WFXO is complete.

3.17 In loop-start operation, the tip lead at the FXS is permanently grounded. When the loop at the FXS is closed, this ground is applied to the ring lead. This condition is transmitted to the 4WFXO/VF or 4WFXO. The loop closure information is applied to the RX latch #1. RX latch #1 and the relay driver energize the LC relay. This closes the loop to the C.O. The C.O. recognizes this as a request for service from the subscriber. Since the loops at both ends are now complete, dialing from the FXS can now take place. Dialing occurs by pulsing of the loop at the FXS. The FXS transmits this condition to the 4WFXO/VF or 4WFXO. The loop pulsing information from the far end is applied to RX latch #1. RX latch #1 and the relay driver pulse the LC LED on/off and energize and deenergize the LC relay to recreate the dial pulsing at the drop to the C.O. At the conclusion of dialing, the talk path from the FXS to the 4WFXO/VF or 4WFXO is complete.

CARRIER GROUP ALARM

3.18 During a system outage, three carrier group alarm (CGA) signals (CGA immediate ground, CGA wink, and CGA delay); option screws [RG], [LC], [EG], and [W]; and option strap [G] control the CGA functions of the unit. When a CGA occurs, the CGA lead provides an immediate ground to the unit, and the CGA DELAY lead provides a delayed ground to the unit. Both grounds remain until the CGA condition is cleared. The CGA WINK lead also provides an immediate ground to the unit, but is opened after a delay, and is then returned to ground until the CGA is cleared. Strapping options on the backplane of the multiplex shelf control when the CGA immediate ground occurs after an alarm signal is received and when the wink pulse (open) occurs after the CGA.

3.19 When the CGA lead is grounded, both the LC and RG relays are deenergized. This opens the loop at the drop and removes the ground on the RSX lead.

3.20 When the CGA DELAY lead is grounded, and option screw [LC] is selected, the LC relay is energized and the LC LED is turned on. This closes the loop at the drop. Additionally, if option screw [RG] is selected, the RG relay is energized causing a ground to be applied to the RSX lead. If option screw [EG] is selected, B relay operates with CGA delay ground.

3.21 When the CGA WINK lead is grounded, and option screw [W] is selected, the B relay is energized. This causes the loop across the B1 and B2 leads to be closed with a wink open after a delay. The B2 lead is normally open (option strap [G] not installed) or grounded (option strap [G] installed).

BUSY MODE

3.22 When the BSY switch is placed in the BSY position, the LC relay is energized and the LC LED is turned on. This causes a loop closure at the drop. If option strap [BF] is installed, a continuous ground is applied to the tip-ground detector which is forwarded to the far-end FXS. Also with [BF], ring-ground is removed by operation of the BSY switch.

4. OPTIONS

4.01 The units are equipped with DIP switch options, screw-down options, and strapping options for selecting circuit options. Refer to Section ITTR-18-441 for detailed information on option selection.

4.02 The multiplex shelf provides options on the backplane which control the CGA timing of the terminal. Refer to Section ITTR-18-405 (for shelves mounted in 23-inch bays) or ITTR-18-406 (for shelves mounted in 19-inch bays) for option selection information on these options.

5. RESTRICTIONS

WARNING: This unit contains static-sensitive (CMOS) devices. Section ITTR-18-599 contains handling instructions for CMOS-equipped units.

6. TEST AND MAINTENANCE FEATURES

6.01 A description of the test and maintenance features of the unit is provided in Table A. Refer to Fig. 1 and 2 for the physical location of these features.

TABLE A

FEATURE	REF. DES.	FUNCTION
LC LED	DS1	Turns on when a loop closure is present at the drop.
BSY Switch	S9	When placed in BSY position, causes loop closure at the drop; with option strap [BF] installed, tip ground also sent to far end.
Splitting Card Jack	J1	Provides test/break jack access to C.O. equipment and channel unit sides of T, R, T1, and R1 leads.
EQ OUT Test Points	TP1 and TP2	Provide monitoring point for the equalizer circuit.

7. TECHNICAL SUMMARY

7.01 A summary of technical specifications for the unit is given in Table B.

TABLE B

ITEM	SPECIFICATION
DC POWER	
Voltage	**Current Drain (nominal)**
– 5V	29.0 mA (idle); 36.0 mA (busy)
– 10V	2.0 mA (at 5V)
+ 7V	5.0 mA (at 12V)
– 17V	7.0 mA (at 12V)
– 48V SIG Battery	0 mA (idle); 10.0 mA (busy)
VF PERFORMANCE	
Impedance	600 ohms balanced; 150 ohms balanced; or 1200 ohms balanced (switch selectable)
Levels	
Transmit	+ 9.0 to – 23.5 dBm, adjustable in 0.1-dB steps
Receive	+ 10.5 to – 22.0 dBm, adjustable in 0.1-dB steps

TABLE B (CONT)

ITEM	SPECIFICATION
Loss Stability (End-to-End)†	± 0.5 dB over life in 95% of the circuits
Tracking (End-to-End)	
– 37 to + 3 dBm0 Input	0.5 dB maximum deviation
– 50 to – 37 dBm0 Input	1.0 dB maximum deviation
Idle Channel Noise (End-to-End)	23 dBrnc0 maximum
Signal-to-Distortion	
0 to – 30 dBm0 Input	33 dB minimum overall; 35 dB minimum receive or transmit
– 40 dBm0 Input	27 dB minimum overall; 29 dB minimum receive or transmit (deviation to 1 dBrnC for – 21 dBm TLP)
– 45 dBm0 Input	22 dB minimum overall; 25 dB minimum receive or transmit (deviation to 1 dBrnC for – 20 dBm TLP)
Single Frequency Distortion (at 0 dBm0)	
Input Swept from 0 to 12 kHz	– 28 dBm0 maximum at any other frequency
Input between 1004 and 1020 Hz	– 40 dBm0 or less at any other frequency of 0 to 4 kHz with a distortion contribution objective from either transmit or receive of typically 6 dB better
Return Loss	
600 ohms	
1000 Hz	28 dB minimum
300 to 3000 Hz	23 dB minimum
150 or 1200 ohms	
1000 Hz	23 dB minimum
300 to 3000 Hz	20 dB minimum

TABLE B (CONT)

ITEM	SPECIFICATION
Frequency Response (Referenced to 1020 Hz, End-to-End)†	
200 Hz	0, −3.0 dB
300 to 3000 Hz	±0.3 dB
3200 Hz	+0.15, −1.5 dB
3400 Hz	0, −3.0 dB
Longitudinal Balance (AT&T or IEEE Method)	
200 Hz	66 dB minimum
1000 Hz	60 dB minimum
3000 Hz	58 dB minimum
†600-ohm setting	
SIGNALING	
Pulsing Distortion	
Input (at FXS)	Loop pulsing at 12 pps, 64% break, with 1500 ohms external circuit resistance
Output (at FXO)	71% break maximum
Input (at FXS)	Loop pulsing at 12 pps, 58% break, 4 C4A ringers, and 15 k ohms leak resistance
Output (at FXO)	43% break minimum
Loop Closure Resistance	600 ohms nominal
Ring/Ground Resistance (on RSX lead)	390 ohms nominal
External Loop Resistance	1800 ohms maximum
Ringing Voltage (at office)	70 to 190 Vrms
OPERATING ENVIRONMENT	
Temperature	0 to +55°C
Humidity	To 95% at 40°C (no condensation)
Altitude	To 14,000 ft (4,300 m)
DIMENSIONS	
Width	0.8 in. (1.9 cm)
Height	5.9 in. (15.0 cm)
Depth	9.7 in. (24.6 cm)
WEIGHT	1.1 lb (0.5 kg)

8. REPLACEABLE PARTS

8.01 These units have no field-replaceable parts.

9. REFERENCES

9.01 The engineering drawings noted in Table C were used in the preparation of this Section.

TABLE C

TYPE	DRAWING NO.
Assembly	628230-000
Schematic	628230-002
Assembly	628235-000
Schematic	628235-002

9.02 Related information on the units may be found in the ITTR Sections referenced in Table D.

TABLE D

TITLE	SECTION NO.
Connectorized Multiplex Shelf (MS/WC7, MS/WC5, MS/C7 and MS/C6), 628001, 628005, 628011 and 628015 (For 23-Inch Bays) — Option Selection, Installation and Pretest	ITTR-18-405
Connectorized Multiplex Shelf (MS19/WC7, MS19/WC5, MS19/C7 and MS19/C6), 628003, 628008, 628013 and 628018 (For 19-Inch Bays) — Option Selection, Installation and Pretest	ITTR-18-406
Special Service Channel Units — Option Selection and Installation	ITTR-18-441